



**National
Transportation
Safety Board**

Highway–Railroad Grade Crossing Collision

U.S. Highway 95

Miriam, Nevada

June 24, 2011



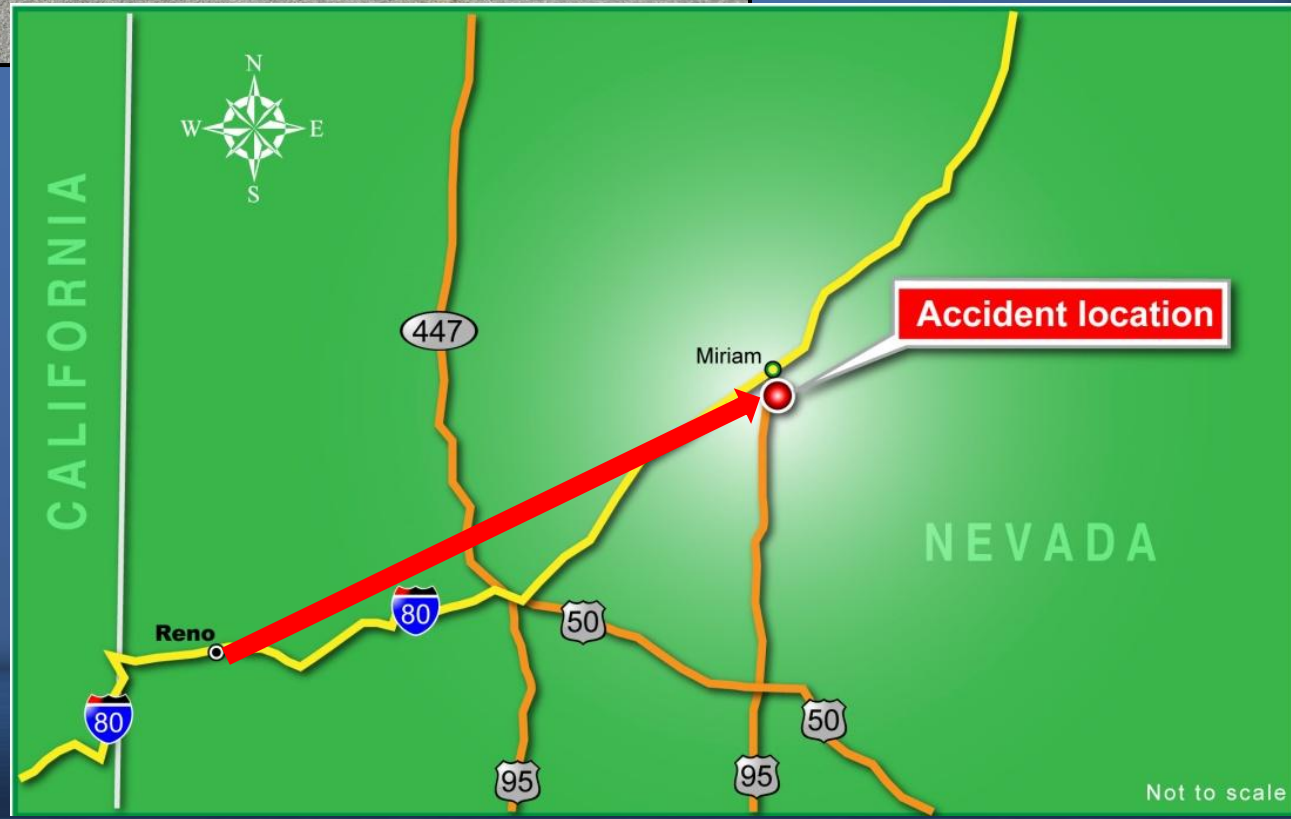
**National
Transportation
Safety Board**

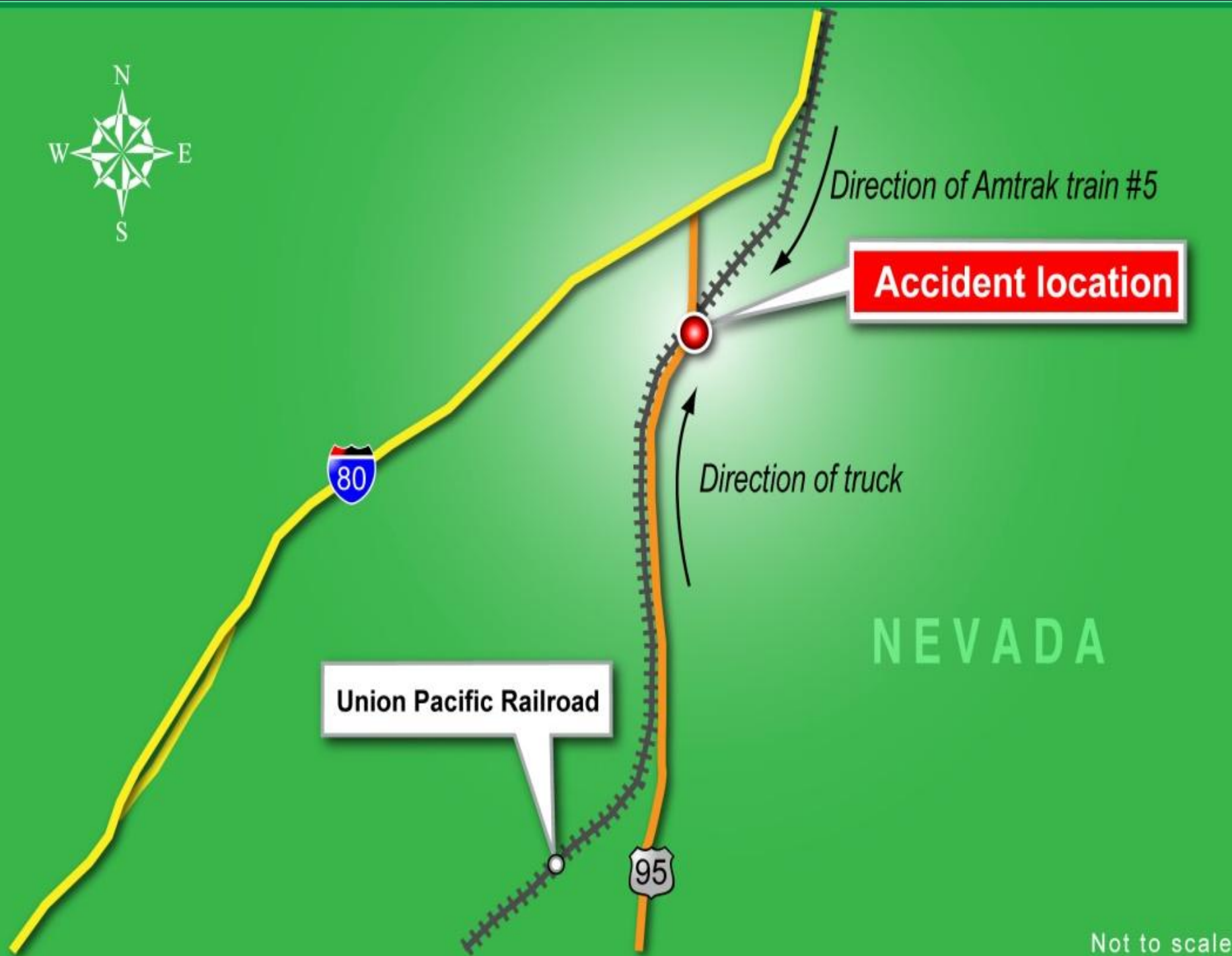
Opening Statement

Robert Accetta
Investigator-in-Charge



Accident Truck Exemplar





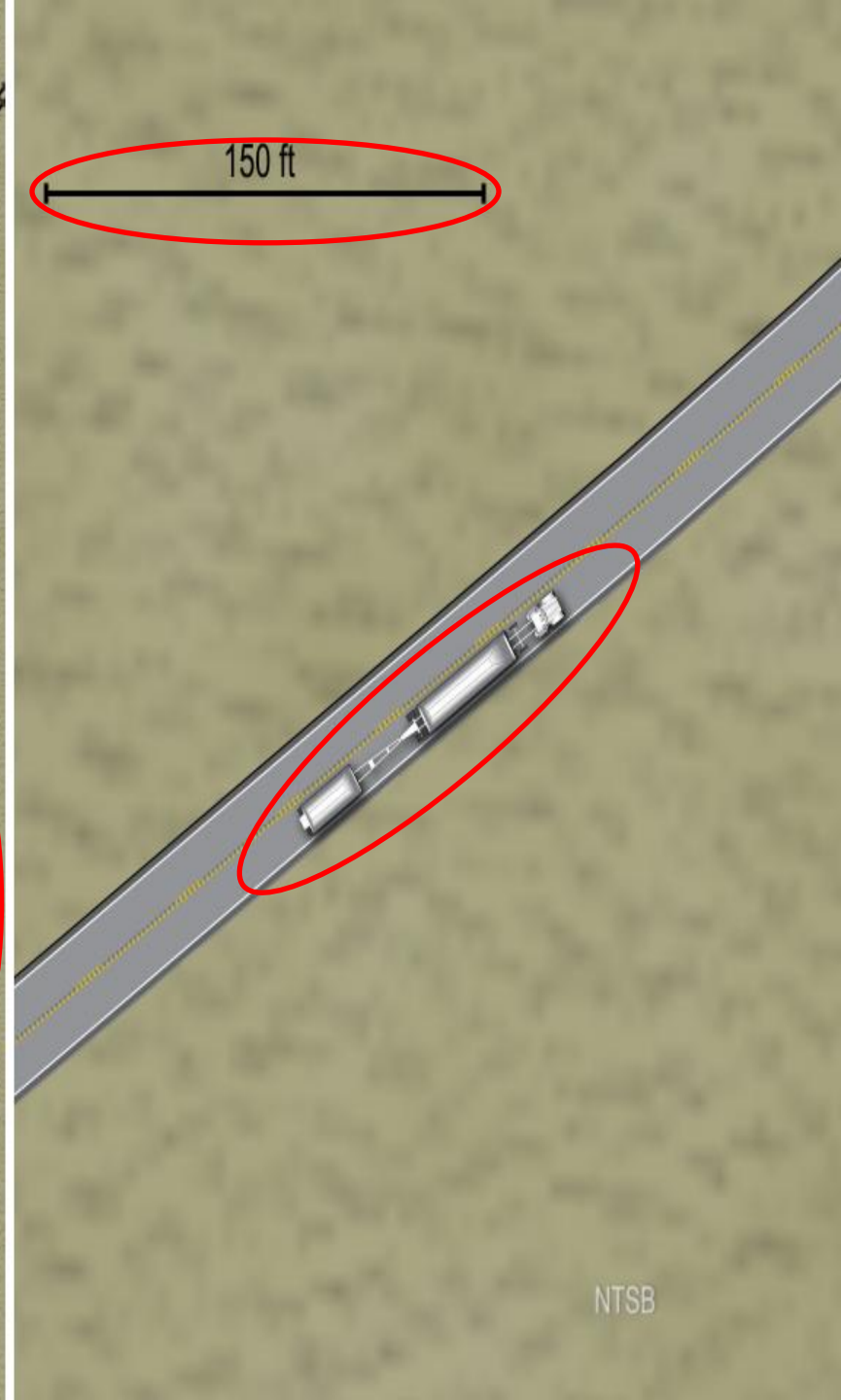
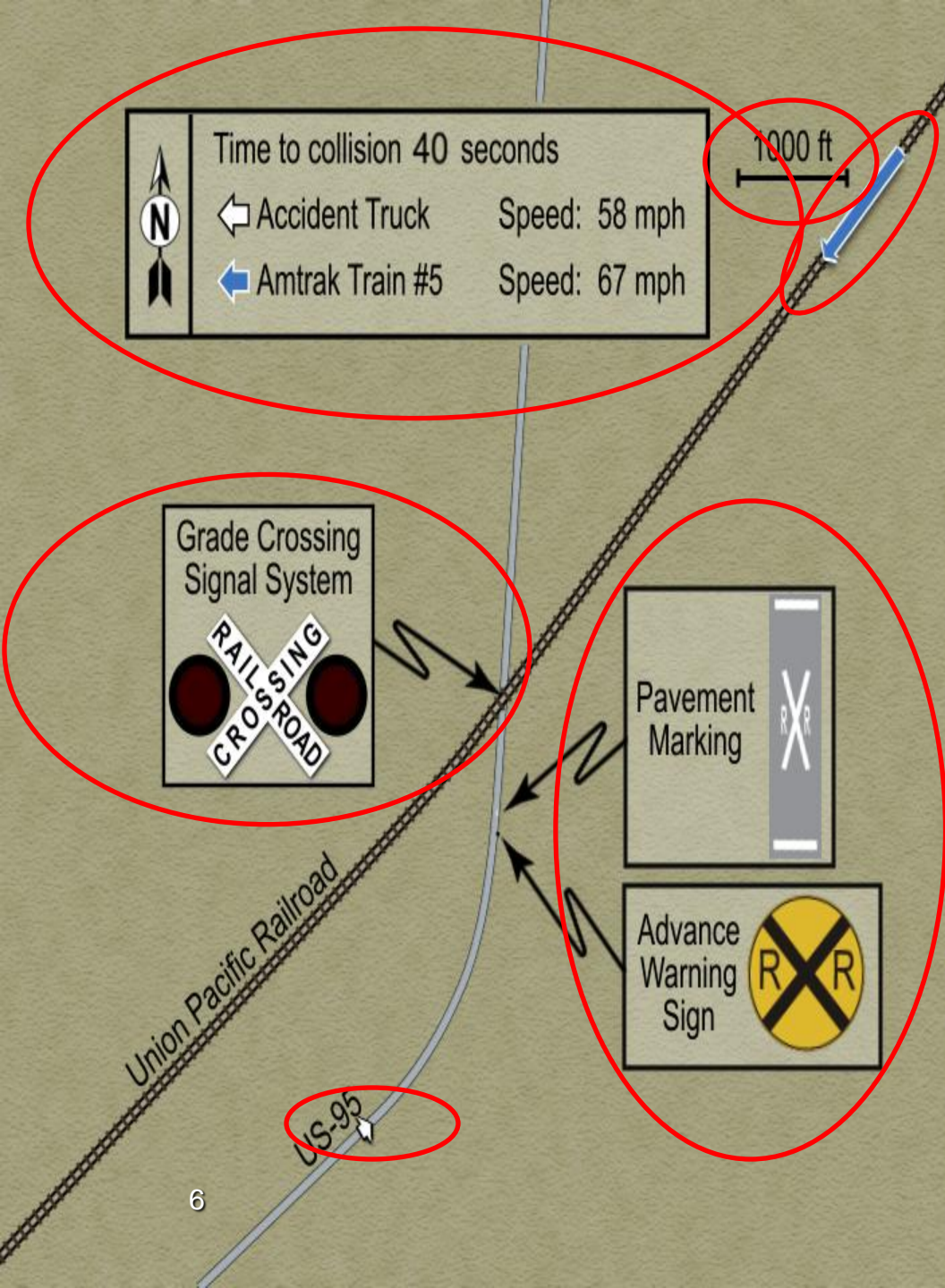
Not to scale



Courtesy Nevada Highway Patrol



Courtesy Amtrak passenger





National Transportation Safety Board

Animation of Accident Reconstruction

Highway-Railroad Grade Crossing Collision, US Highway 95

Miriam, Nevada

June 24, 2011

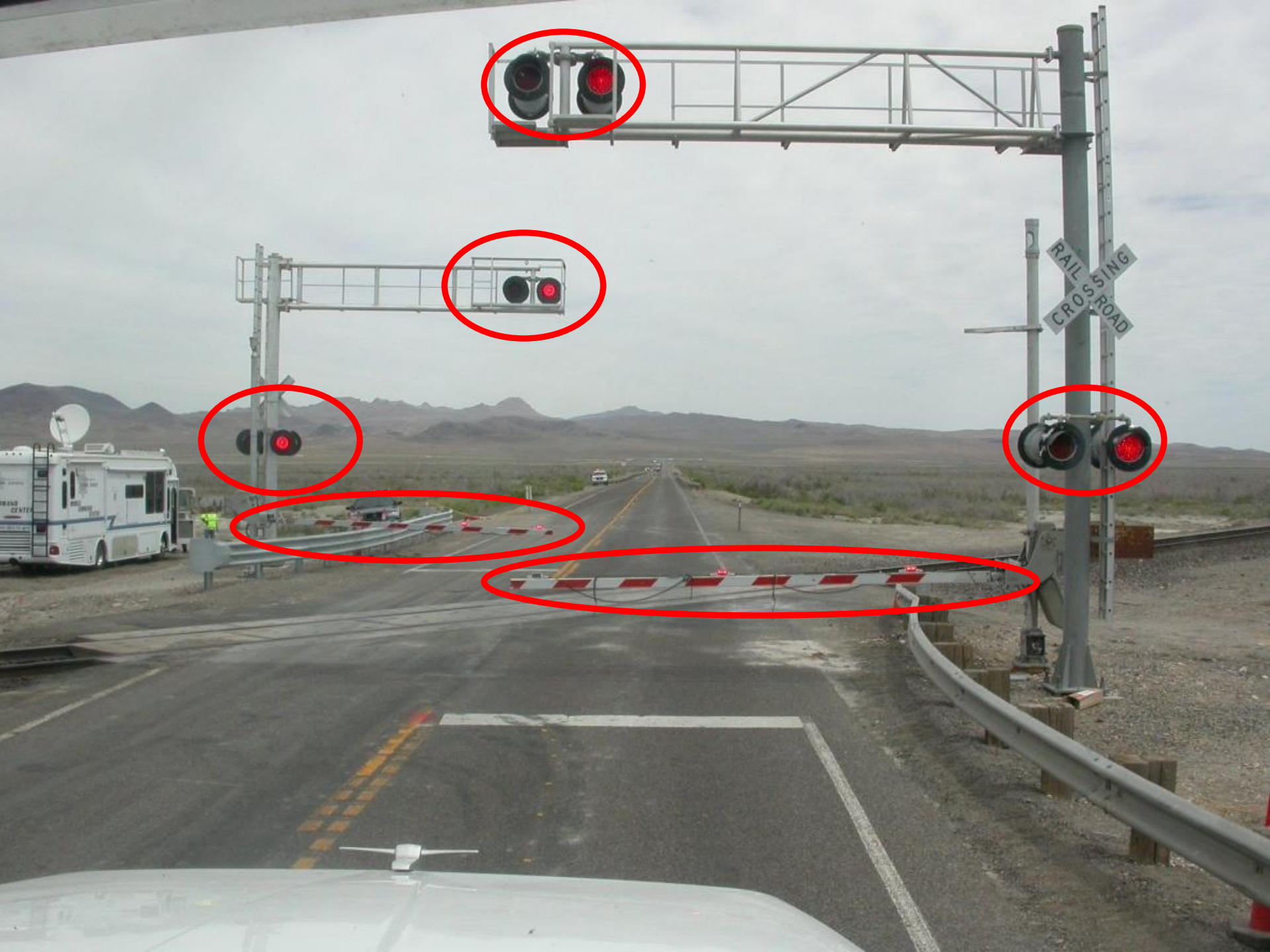
HWY11MH012



Tire marks depicted in this photograph are not from the accident truck







Amtrak train #5 video frame capture at 11:19:24 a.m.





24 1:36PM

Train Damage

- 2 passenger railcars – severe impact damage + engulfed by fire
- 1 passenger railcar – moderate smoke/fire



Source: Fallon Churchill
Vol. Fire Department

Injury Information

Truck driver – fatality

Amtrak train

- 195 passengers
 - 4 fatalities
 - 15 injured
- 14 train crew members
 - 1 fatality
 - 1 injured

NTSB On-Scene Staff

- Earl Weener, PhD Board Member
- Suzanne TeBeau Rohde Special Assistant
- Robert Accetta Investigator-in-Charge
- Jana Price, PhD Human Performance
- Gary Van Etten Motor Carrier
- Jennifer Morrison Vehicle Factors
- Steven Prouty Vehicle Factors
- Dan Walsh, P.E. Highway Factors
- Tom Barth, PhD Survival Factors
- Ronald Kaminski Survival Factors
- Pummy Bawa Computer Support

NTSB On-Scene Staff (cont'd)

- Dave Watson Railroad Mechanical
- Tim DePaepe Railroad Signals
- Ted Turpin Railroad Operations
- Rick Downs, P.E. Railroad Survival
- Jane Terry Government Affairs
- Elias Kontanis, PhD TDA
- Max Green TDA
- Deborah Hall TDA
- Peter Knudson Public Affairs
- Nicholas Worrell Public Affairs
- Joe Panagiotou Fire & Explosions

Investigative Support Staff

- Doug Brazy Vehicle Recorders
- Dan Horak, PhD Video Analysis
- Shane Lack Vehicle Performance
- Robert Squire Accident Reconstruction
- Robert Combs General Counsel

Report Development Staff

- | | |
|------------------------|-----------------|
| • Rafael Marshall, PhD | Project Manager |
| • Michele Beckjord | Research |
| • Michael Fox | Research |
| • Debbie Stocker | Report Editor |
| • Robert Turner | Graphics |
| • Christy Spangler | Graphics |
| • Julie Perrot | Recommendations |
| • Patrick Sullivan | Recommendations |
| • Robert Molloy, PhD | Audio/Visual |

Parties to Investigation

- Federal Motor Carrier Safety Administration
- Federal Highway Administration
- Federal Railroad Administration
- Nevada Department of Transportation
- Nevada Department of Public Safety
- Churchill County Sheriff's Office

Parties to Investigation (cont'd)

- National Railroad Passenger Corp. (Amtrak)
- Union Pacific Railroad
- Brotherhood of Locomotive Engineers and Trainmen
- United Transportation Union
- John Davis Trucking Company

Safety Issues

- Driver distraction & fatigue
- Commercial driver license & employment history
- Commercial vehicle brake maintenance
- Railcar crashworthiness & fire protection
- Grade crossing action plans



National Transportation Safety Board



**National
Transportation
Safety Board**

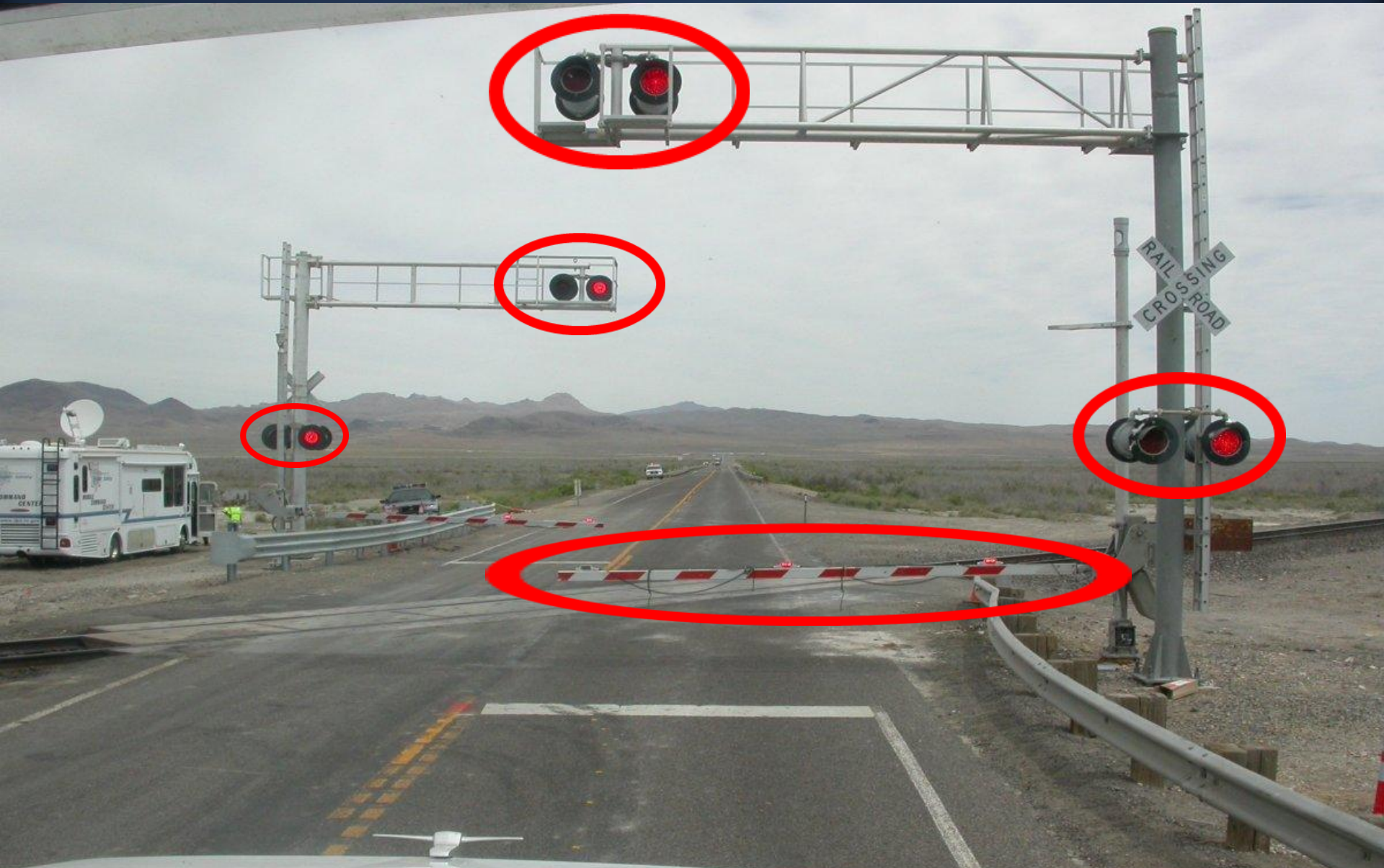
Human Performance

Jana Price, Ph.D.

Human Performance Issues

- Ability to see/hear train warnings
- Fatigue
- Distraction

Ability to See Warnings



Ability to See Warnings

	Feet	Seconds to collision (approx)
Signal begins activation	2,400	30
Signal fully active	1,500	18
Advance warning sign	900	11

Based on a constant speed of 57.8 mph



Ability to See Warnings

- Clear forward view of activated signals 900 feet before crossing
- No evidence of truck slowing for 6-7 seconds after passing sign
- No visual obstructions or glare
- Mild visual impairment would not have affected driver's ability to see warning

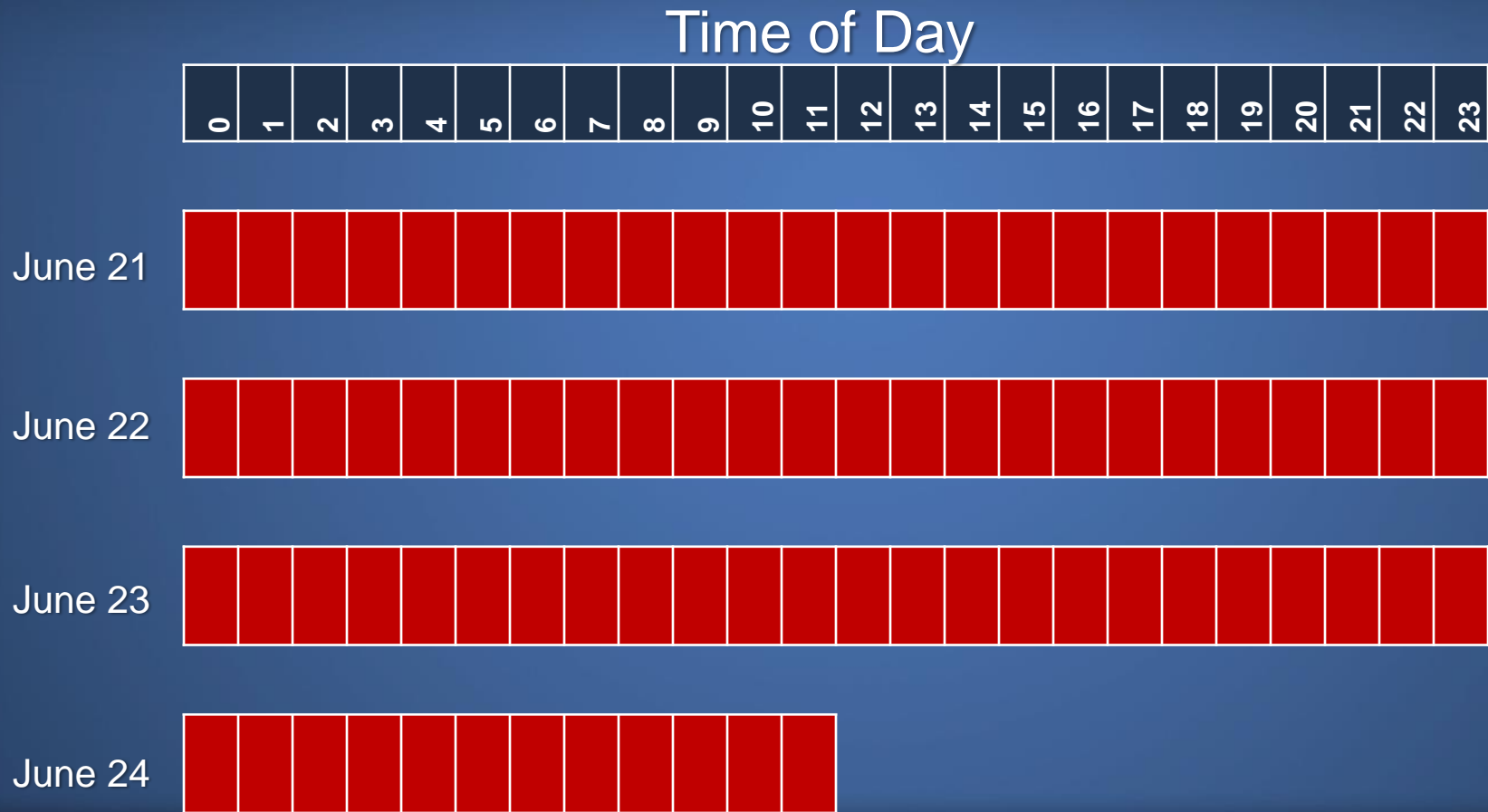
Ability to Hear Train

- Crossing bell and train horn
- Driver's hearing normal
- Horn sounded 4 times as train approached crossing
- Auditory field test: train horn sounds 10-13 dB below ambient vehicle sounds

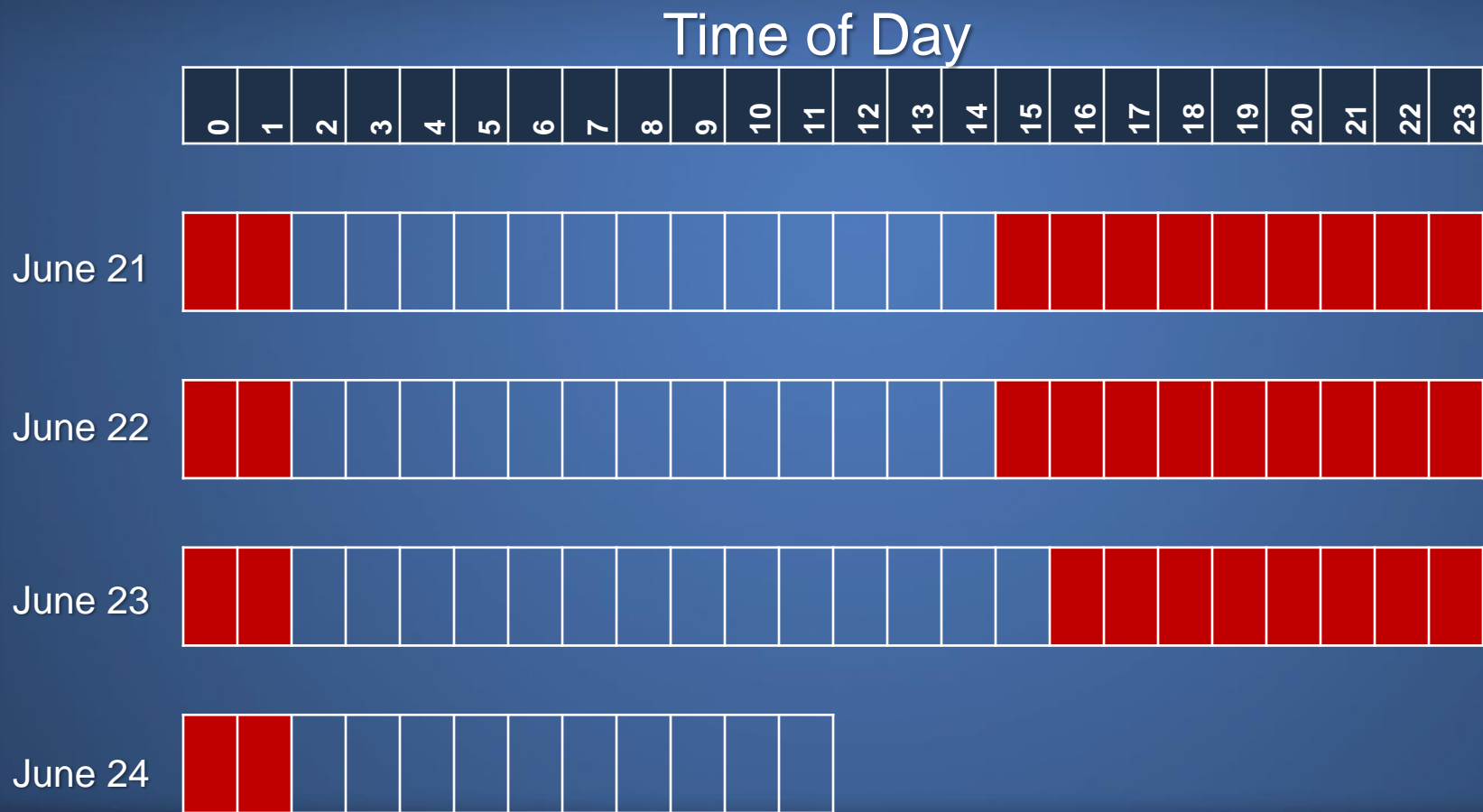
Fatigue

- Sleep length, timing, quality
- Medical issues
- Task factors
- Performance

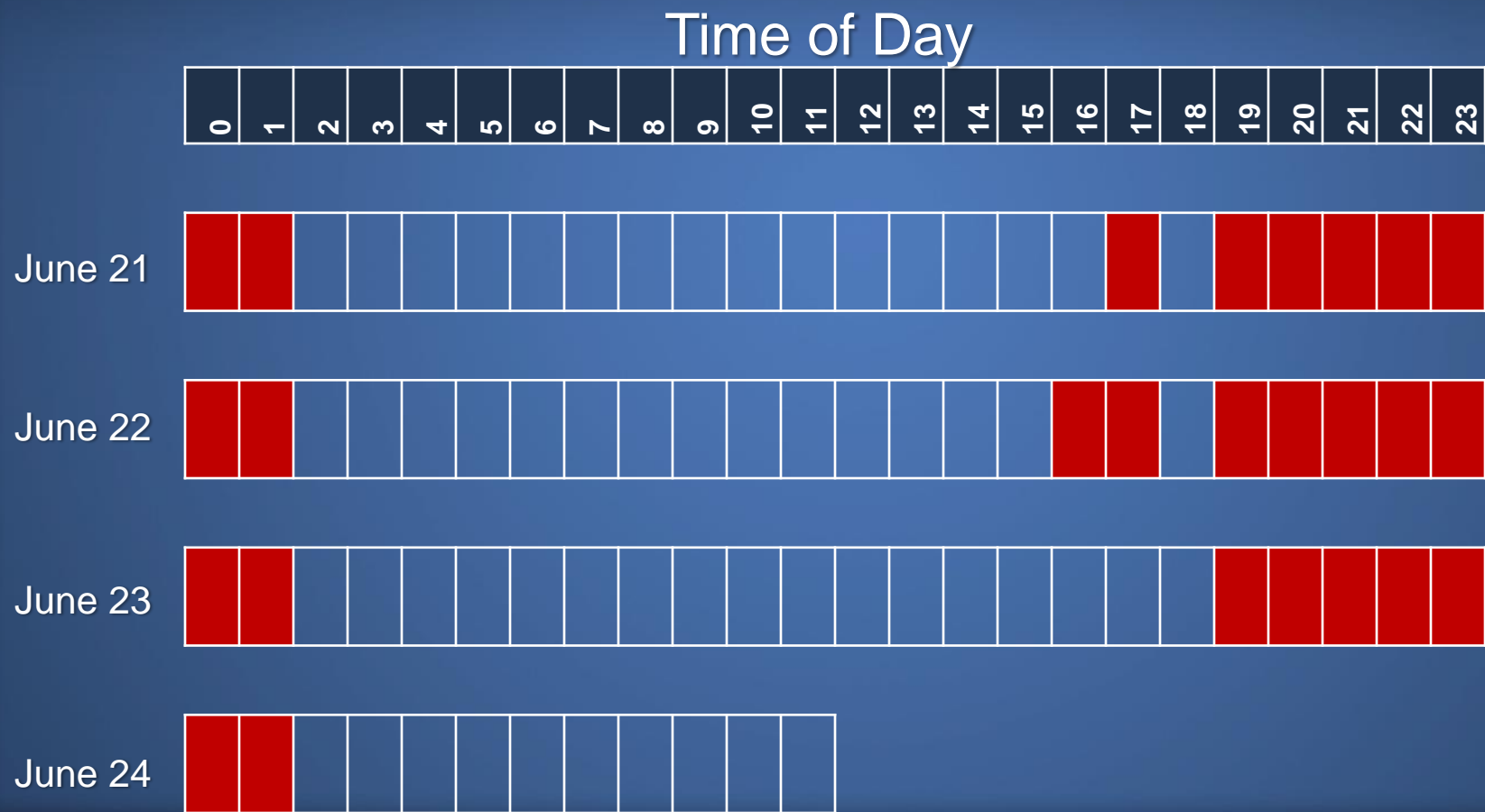
Driver Sleep Opportunities



Driver Sleep Opportunities



Driver Sleep Opportunities



Fatigue Factors

- Weekday/weekend sleep times
- Possible sleep debt
- Ankle pain
- Driving environment

Distraction

- Driver routinely used hand-held cell phone while driving
- In 8 hours before accident
 - 30 outgoing voice calls
 - 1 incoming voice call
 - 4 voicemail checks
 - 1 text message
 - 3 Internet uses

Distraction

- Last outgoing call 47 minutes before accident
- Last incoming call 2 minutes before accident, routed to voicemail
- 4 calls to orthopedic clinics within 3 hours of accident

Summary

- Vehicle noise masked train horn
- Driver had clear forward view of activated signal for 900 feet
- Potential factors contributing to delayed braking
 - Driver fatigue
 - Cell phone distraction
 - Distraction from pain



National Transportation Safety Board



**National
Transportation
Safety Board**

Motor Carrier Factors

Gary Van Etten

Overview

- Required hiring practices
- Accident driver's employment history
- Accident driver's driving history

Hiring Regulations

- Required background and character process
 - Complete job application
 - All accidents and traffic violation convictions for previous 3 years
 - All employment for previous 3 years
 - All CMV employment for previous 10 years

Hiring Regulations

- Investigation by potential employer
 - Must obtain applicant's 3-year driving history
 - Contact previous employers – 3 years
 - Driver identification and employment verification
 - Accidents
 - Violations of alcohol or drug regulations
- Must obtain applicant's written permission

Accident Driver's Employment History

- Listed 3 CMV employers in previous 3 years
- Listed 10 jobs in previous 10 years, 7 were CMV employers
- Driver held as many as 30 jobs in that same 10 years, up to 22 of which were CMV employers, and most not listed on application

Driver Employment History

- Self reporting
 - Omitted previous employment
 - Omitted or falsified reason for leaving previous job
- “Please contact later” – on job application
- Unreported history of poor performance

Driver Violation History Databases

- State Department of Motor Vehicles
- Commercial Driver's License Information System (CDLIS)
- National Driver Register (NDR)

Driver Histories Obtained

Violation	3-Year (John Davis)	10-Year (NTSB)
Speeding	3	9
Seat belt non-use	2	2
No insurance	0	1
License suspensions	0	8
Traffic accidents	1	2

Summary

- Self-reporting of previous employment – inadequate
- Carrier inquiry into driver history – needs improvement



National Transportation Safety Board



**National
Transportation
Safety Board**

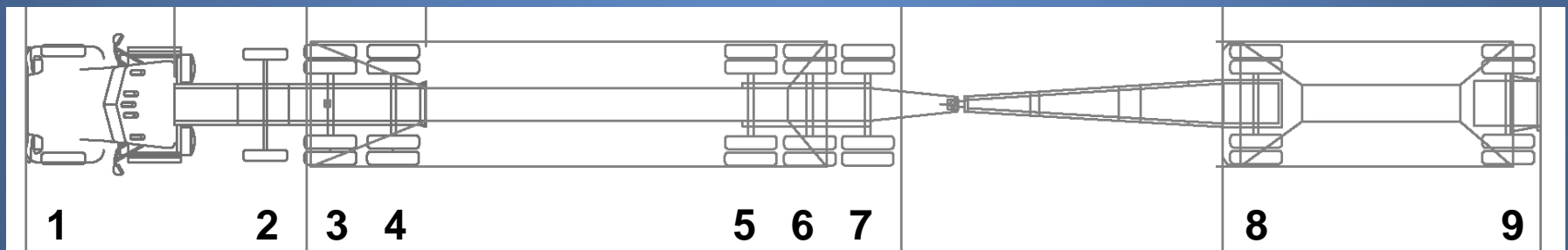
Vehicle Factors

Jennifer L. Morrison

Vehicle Factors

- Description of vehicle
- Condition of brakes
 - Numerous defects
 - Improper post-crash brake measurement and alteration
 - Improper maintenance
- Brake stroke monitoring systems

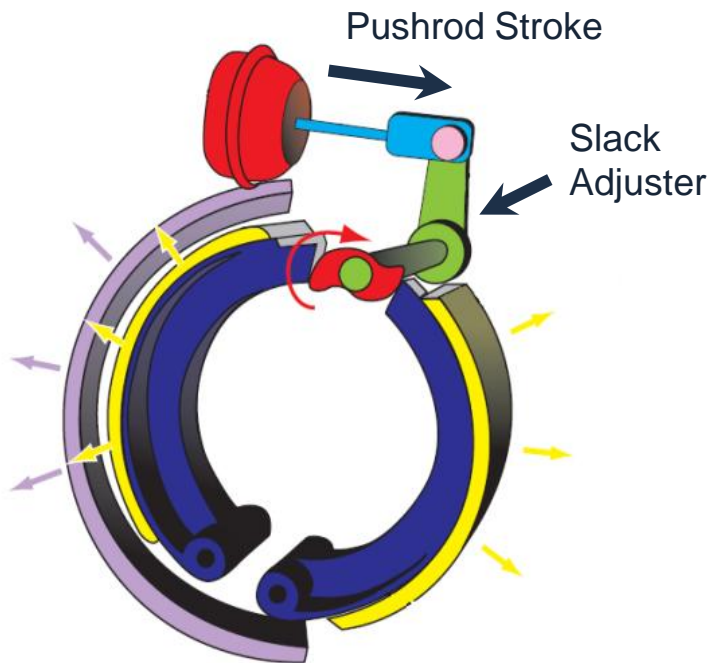
Accident Vehicle



49,500 pounds - 105 feet long - 9 axles

Condition of Brakes

Air Drum Brake Diagram



Of 16 brakes in service

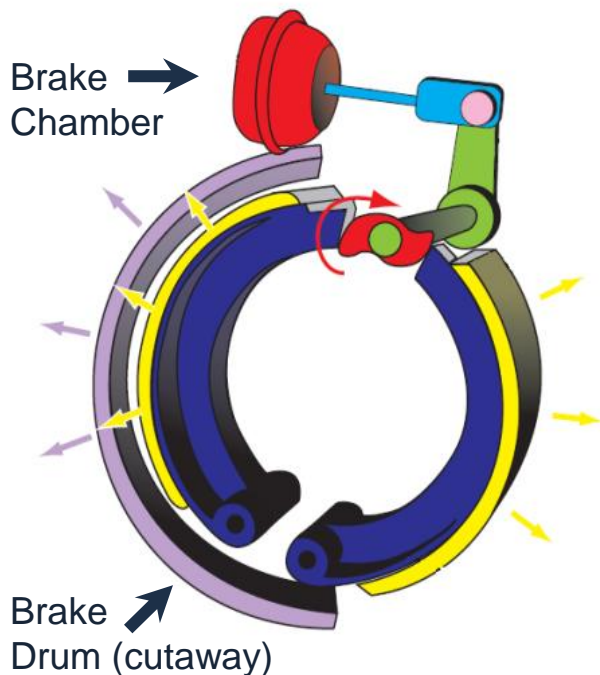
- 9 out-of-adjustment or inoperative

However:

- Measured at high pressure:
120 vs. 90-100 psi
- Slack adjusters backed off, altering brakes

Condition of Brakes (cont.)

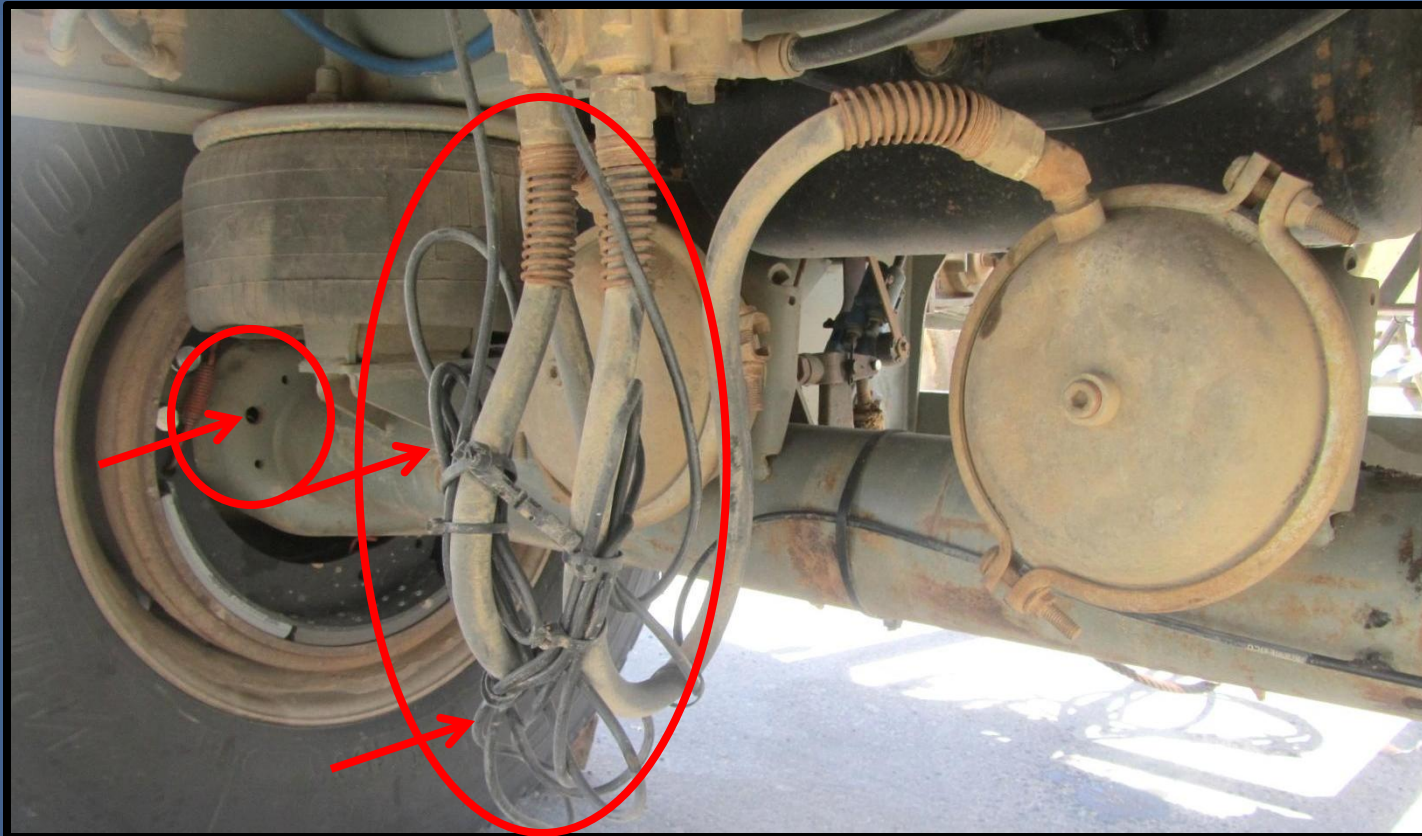
Air Drum Brake Diagram



Of 16 brakes in service

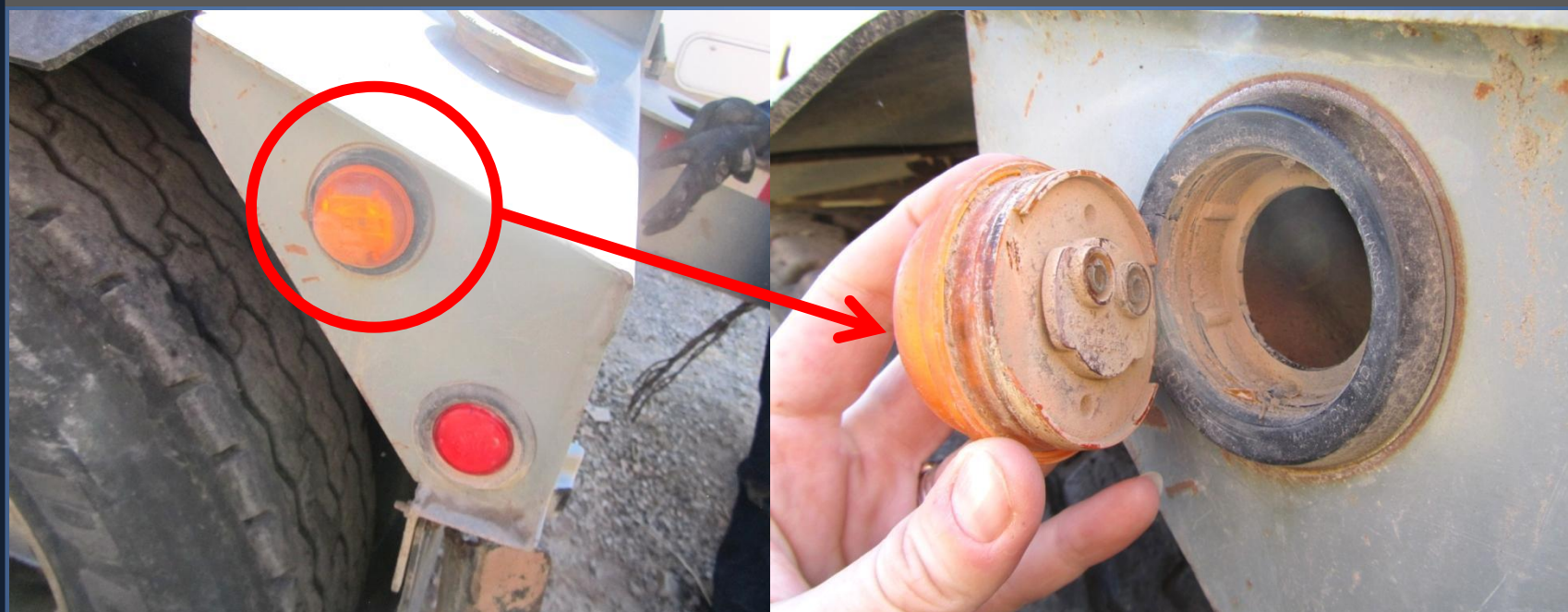
- 2 axles with mismatched/incorrect chambers
- 11 brake drums worn beyond specified limits
- Missing and disconnected antilock braking components

Condition of Brakes - ABS Defects

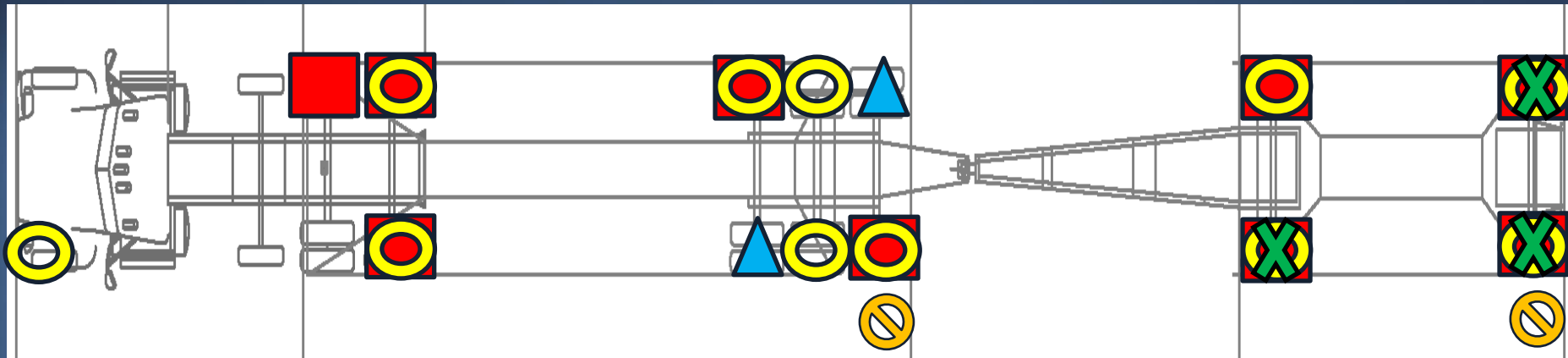


Condition of Brakes - ABS Defects

ABS malfunction indicator light disconnected on trailer 1



Condition of Brakes - Summary



9 out-of-adjustment/inoperative brakes (NHP)



2 mismatched/incorrect brake chambers



11 worn brake drums



3 missing/disconnected ABS sensors



2 disconnected ABS malfunction indicator lights

Maintenance

Improper
Maintenance



Brake Defects

Not using proper
replacement parts



Mismatched & incorrect
brake chambers

ABS component removal,
cutting of wires



Nonfunctional ABS

Frequent manual
adjustment of automatic
slack adjusters

(Glenrock, PA)



Out-of-adjustment brakes

On-Board Brake Stroke Monitoring Systems

- Incorporate sensors into foundation brakes
- Driver interface
- ~ \$1,200 – \$2,500
- Original equipment or aftermarket
- FMCSA has “Product Guide”
- No current standards or requirements
- Can provide valuable information to:
 - Driver
 - Maintenance personnel
 - Commercial vehicle inspectors



Summary

- Numerous brake defects found
 - Improper maintenance
- Recommendations
 - Proper pushrod stroke measurements
 - Not backing off slack adjusters
 - Proper vehicle maintenance
 - Benefits of brake stroke monitoring systems



National Transportation Safety Board



**National
Transportation
Safety Board**

Survival Factors

- Railroad
- Highway

Richard M. Downs, Jr., P.E.

Thomas H. Barth, Ph.D.

Survival Factors - Railroad

- Passenger railcar safety issues
 - Sidewall crashworthiness
 - Carbody end-door – smoke/fire propagation



Passenger Railcar Crashworthiness

- Crew sleeper car *lower level*
 - Struck by truck-tractor
 - Sidewall breach ~ 40 feet
 - Truck-tractor came to rest on lower level
 - Loss of occupant survival space
 - 1 fatal + 1 serious injury



Passenger Railcar Crashworthiness

- Coach car *upper level*
 - Struck by lead trailer
 - Sidewall breach ~ 33 feet
 - Loss of occupant survival space
 - 4 fatal + 2 serious injury, 11 minor injury



Passenger Railcar Crashworthiness

- Development of 49 CFR 238.217 Side Structure
 - 1997 NPRM:
 - Based on AAR standard S-034-69,1984
 - FRA; criteria might not be sufficient, interim measure
 - No FRA action to date
 - 238.217 and S-034-69,1984 (side structure criteria):
 - Technically similar
 - Do not incorporate “crash energy management”

Crashworthiness Findings

- Carbody sidewall is vulnerable to intrusion
 - Current regulation based on AAR Standard; not adequate to ensure passenger safety
 - Improvement of side impact requirements needed in 49 CFR 238.217



Passenger Railcar Fire Safety

- Smoke/fire propagation
 - Truck-tractor fuel tanks contained ~100 gallons diesel
 - Fire started in crew sleeper car, spread to passenger coach cars



Passenger Railcar Fire Safety

- Fire causation and propagation review
 - Fire spread – breached sidewall panels
 - Railcar end-doors apparently left open during evac
- 49 CFR Part 238
 - No requirement for passenger railcar end-doors to be fire doors
 - Fire doors can delay spread of smoke and fire, and prevent injury without impeding emergency egress

Summary

- Current side impact strength design practices and regulation are inadequate to prevent sidewall intrusion/loss of occupant survival space
 - Improve regulation/incorporate “crash energy management”
- Fire doors in passenger railcars
 - Can delay spread of smoke/fire
 - Can increase rescue time for entrapped/injured/disabled persons or for elderly evacuation



National Transportation Safety Board



**National
Transportation
Safety Board**

Highway Factors

Dan Walsh, P.E.

Overview

- Roadway characteristics on US-95 prior to grade crossing
- Actions taken by Nevada DOT post accident
- Federal legislation requiring states to develop grade crossing action plans

Roadway Characteristics

- 2-lane undivided highway
- Posted speed limit 70 mph
- Horizontal curvature consisted of 3,000-foot radius curve
- Crossing of Union Pacific railroad and US-95 formed skew angle of approximately 139 degrees

Actions Taken by Nevada DOT

- Conducted diagnostic review in November 2011
- Installing new AAWS cantilevered over travel lanes on US-95
- Creating “standard” for rural railroad crossings with speeds limits greater than 65 mph
- Creating new hazard index formula



Grade Crossing Action Plans

- 1994 *Action Plan for Highway-Rail Crossing Safety and Trespass Prevention*
 - Goal to reduce accidents and fatalities at grade crossings by 50 percent
 - From 1994 to 2002, fatalities decreased by 42 percent
 - 55 initiatives grouped into six broad categories
 - Not specific to each state

FRA Final Rule

- FRA Final Rule (June 2010) – 10 states
 - Action plans cover 5 years
 - No requirement to conduct evaluations
 - No requirement to create minimum safety standards
 - No requirement to develop model action plan to promote uniformity among states

FHWA Website

- Type of information that should be included in report
 - Scope and cost of improvements
 - Types of improvements
 - Location of improvements
 - Effectiveness of prior improvements
- Website developed in May 2006
 - Has not been updated

Summary

- Evaluate 10 states action plans at end of 5 years
- Develop model grade crossing action plan
 - Promote consistency
 - Help each state track progress
 - Help other states assess and improve action plans



National Transportation Safety Board